•LOADS, SPEED, MOTORS & DIFFERENTIAL GEARING

GMCWS technical seminar 10/10/2006

By
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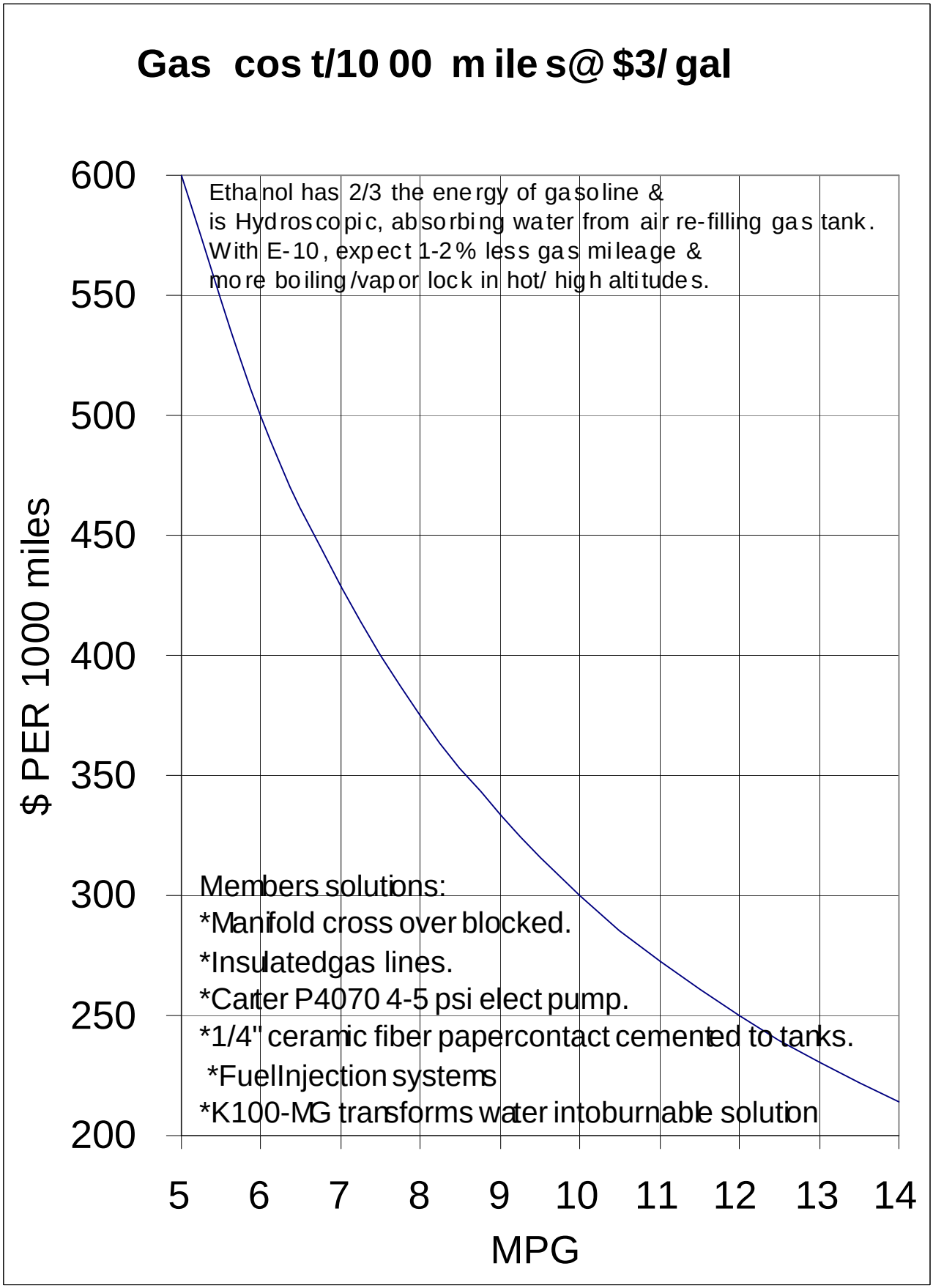
Like their owners, and after nearly 30 years of “improvements by multiple owners”, no two coaches are the same. How they are used is also as different as their owners. Then there is the level of current maintenance, wear, and tuning. Many coaches are heavier and tow more weight than their design specifications. Owners also drive at different speeds. Owners often desire more power and many things need to be considered when choosing an option, especially in the west with its higher altitudes and long steep hills.

This seminar will present test data of some options and combinations to enable you to make better decisions about what you want to do to improve your rig’s performance and driving pleasure. Options were limited to what could be accomplished by the owner or by one of the GMC motorhome specialists.

*Change driving speeds
*Reducing rig weight, including tow
*Relatively inexpensive Dyno tuning can correct many power problems.
*Change differential gearing to match your speeds and loads.
*Rebuild your motor. Only stock, competition cam and Coop motor tested.

In traveling, one of the major cost factors is gasoline. With the exception of one GMCWS member who installed a Diesel and claims 13 mpg, twenty owners who came to the GMC Pacific Cruisers Dyno Shop Rally reported between high sevens to the high nines mpg. All owner’s travel over western mountain passes.


Gas cost/1000 miles@ $3/gal
Ethanol has 2/3 the energy of gasoline &
is Hydroscopic, absorbing water from air re-filling gas tank.
With E-10, expect 1-2% less gas mileage &
more boiling/vapor lock in hot/ high altitudes.
Members solutions:
*Manifold cross over blocked.
*Insulatedgas lines.
*Carter P4070 4-5 psi elect pump.
*1/4" ceramic fiber papercontact cemented to tanks.
*FuelInjection systems
*K100-MG transforms water intoburnable solution
$ PER 1000 miles
600
550
500
450
400
350
300
250
200
5
6
7
8
9
10
11
12
13
14
MPG

I chose $3/gal for comparison because the US Governments Hydrogen fuel program's target is to deliver Hydrogen fuel energy equal to $3/gal of gasoline by 2010. To make its Hydrogen fuel program a success, gasoline will need to cost that much.

The Ethanol in E-10 is hydroscopic, absorbing water from the air refilling the gas tank. The problem is that in the presence of any water, the ethanol forms a cloudy water laden mixture, often within a month, which can clogs filters, fuel systems, including carburetor or FI systems. When E-10 is saturated with water, it will go through a "phase separation", and the water being heaver, sinks to the bottom of the tank. That may rust our steel tanks. As it separates from the E-10, it appears to take some of the octane boosting agent with it and fuel quickly deteriorates from 89 to ~ 82 octane. If your motor is hard starting, has poor idling, or is running rougher and/or knocking more under load, this may be your first sign that you have water in your E-10 fuel.

The second problem with E-10 is that it acts as a solvent. When it dissolves old sludge in your tanks, the hard particles that were contained in the sludge will be set free to clog the fuel filters.

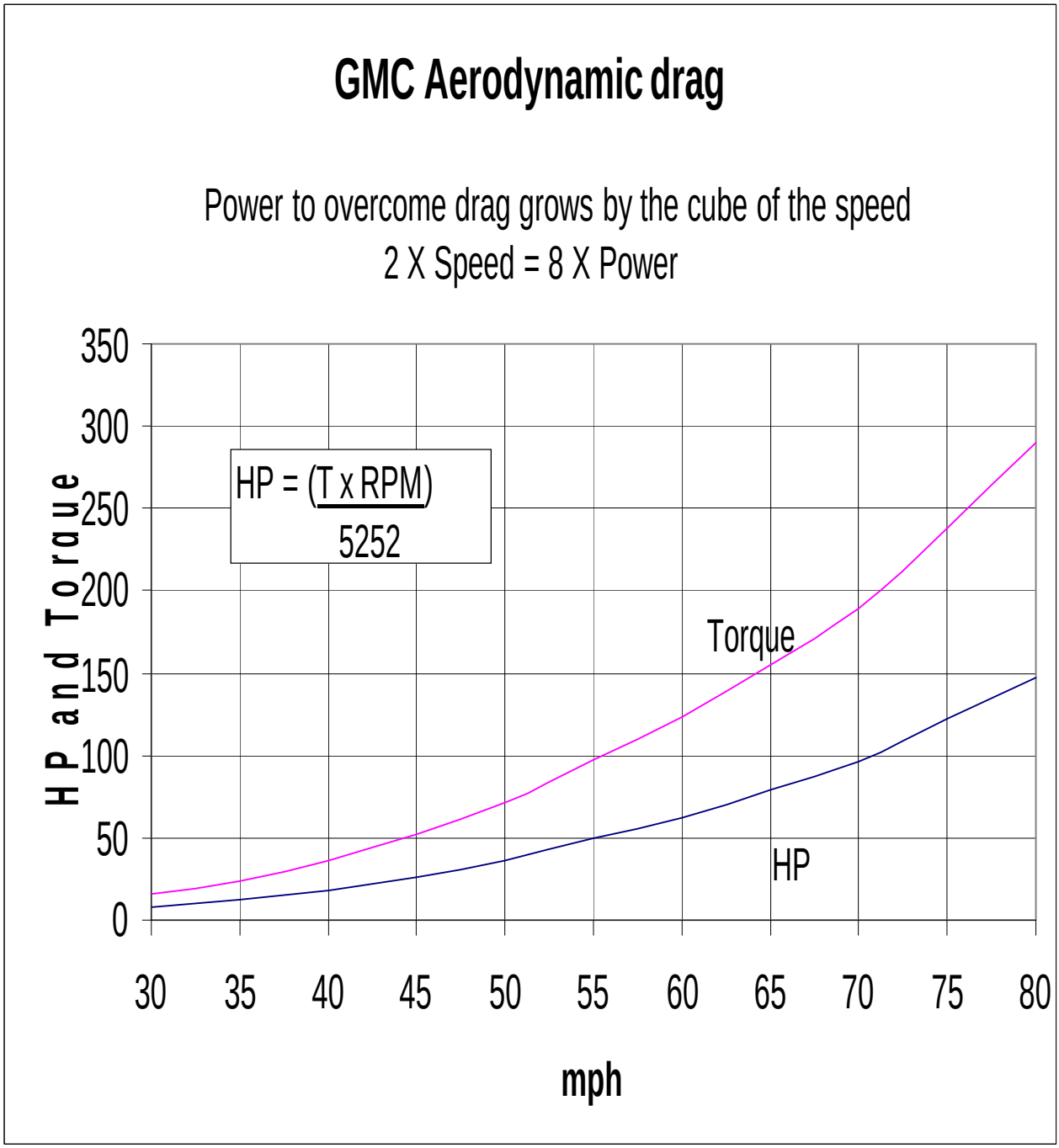
One product to transform the water into a combustible solution is K100-MG. It totally encapsulates the water and eliminates the problems associated with water contamination. K100-MG dissolves gums and varnishes, and contains an enhanced stabilizer that will bring back old fuel that was stored without a stabilizer. It was developed for storage of recreation vehicles. "We make water burn".

To clean up a fuel system with an unknown amount of water contamination, the manufacturer recommends adding an 8 oz bottle per 16 gallons. Add to a nearly empty gas tank to use the least amount of K100-MG..

http://k100fueltreatment.com/ethanol.html
http://k100fueltreatment.com/recreational.html

LOADS

What loads does the drive train need to overcome?



The energy needed to push air out of the way is termed aerodynamic drag. General Motors published test data on how much horsepower (HP) it takes for a standard 26’ GMC to drive at different speeds.

I converted HP to Torque for consistency in this discussion, which uses Torque rather than HP for comparisons. Torque moves our coaches. HP is a calculated value by measuring Torque and rotational speed (rpm) and a 5252 constant established by Robert Fulton of steam engine fame. Fulton created the term horsepower (HP) to compare the work of one horse to his steam engines ability to do the same work. HP started as a marketing tool and has remained that way over time.

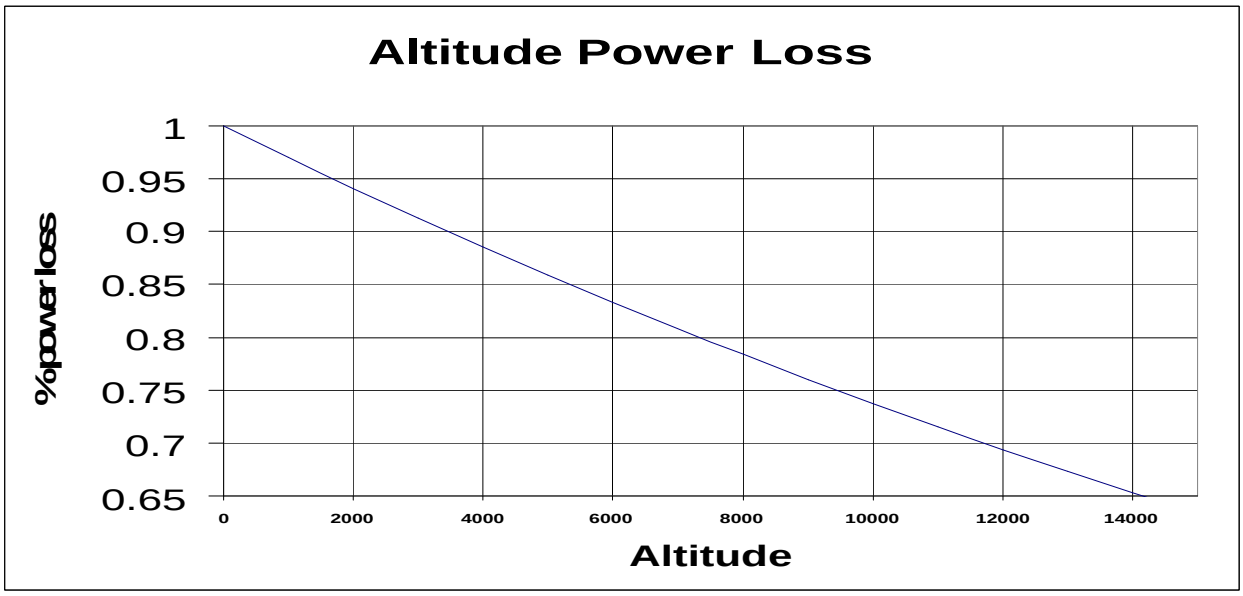
Torque increases with rpm in a gas motor before it levels off and then decreases. The point of maximum torque is usually near the point of greatest efficiency. Automatic transmissions are designed to shift gears based on torque as related to vacuum and rpm.

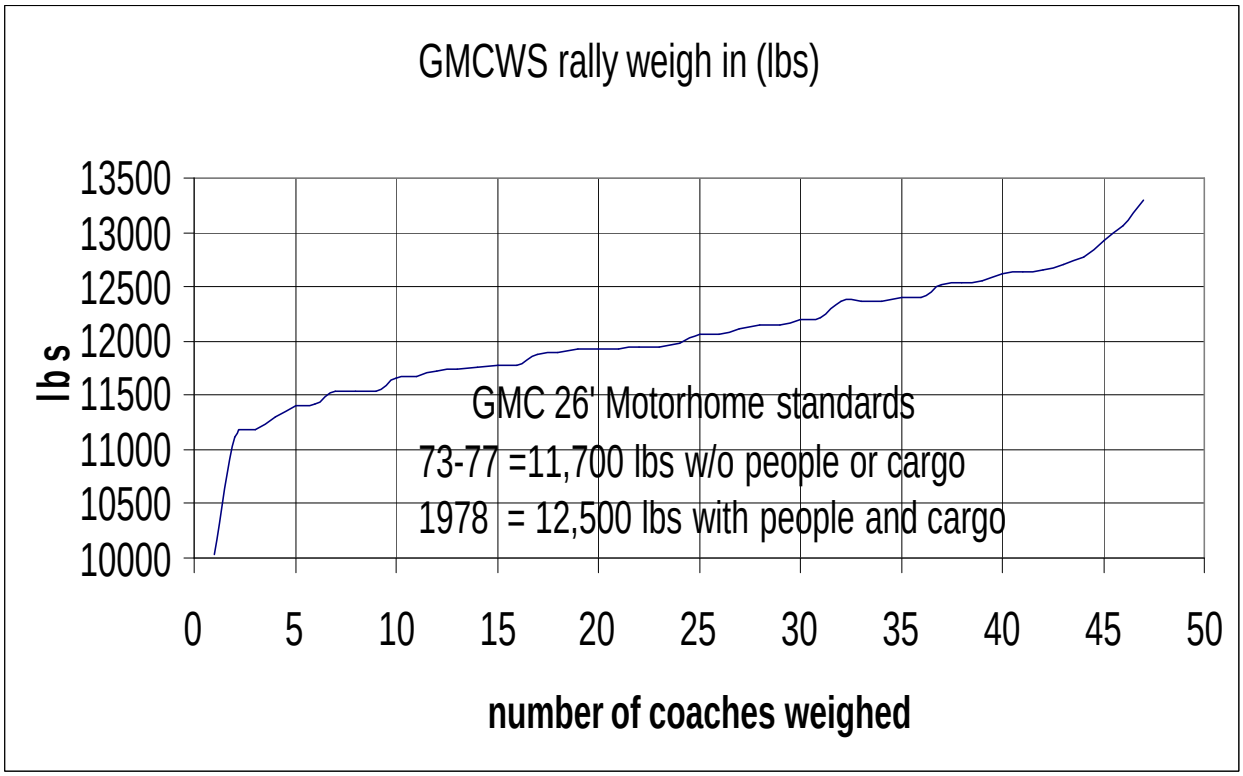
This chart shows the power used to overcome aerodynamic drag. Aerodynamic drag increases by the cube of the speed. If you double your speed, the aerodynamic drag increases by eight times (2 cubed = 8). The speed you travel affects your choice of gearing to match your engine power (torque) curve and your gasoline consumption. More about engine torque curves later. Generally, those who reported driving their GMC’s at lower speeds reported higher mpg, which was the objective of the Federal 55 mph speed limit.

GMC Pacific Cruisers members reported freeway cruising speeds between 60 mph and 75 mph. Other owners reported traveling at 55 mph with their heavier tows at higher altitudes.

Those in the west can attest to lack of power with increasing altitude.

This chart shows the % of motor power lost due to lower air pressures at higher altitudes.





This “weigh in” was done in conjunction with the GMCWS Tire Safety Seminar and it shows that nearly half of the coaches were overweight compared to the GMC Design and testing standards. This “weigh in” did not include tow weights. Coaches and tows in combination that weigh more than the specifications and drive slower than the 75 mph design criteria are candidates for increasing the final drive gear ratio.

The largest tow weight reported by GMCPC members was 9,800 lbs, which far exceeds the GM specification of 1,000 lb maximum tow weight. This only shows the imbalance between the stock 3.07 gear ratio and the increased loads that some members have. That member with the 9,800 lb tow reported gas mileage on his 403-powered coach traveling at 65 mph as 8 mpg. Only one member reported lower gas mileage of 7.7/8.0 mpg pulling a 2,500 lb tow at 60 mph. That member’s Dyno test also identified an inoperative TVS switch, which prevented vacuum advance.

Overweight coaches may need to change to E rated tires and operate at higher pressures to match those increased tire loads.

TIRES & LOADS

STATIC LOAD SETS INDUSTRY STANDARD COLD PRESSURE FOR THAT TIRE SIZE. LARGEST LOADED TIRE SETS TIRE PRESSURE FOR THAT AXIAL. INDUSTRY STANDARDS CHARTS OF PRESSURES VS LOADS AT DEALERS/INTERNET.

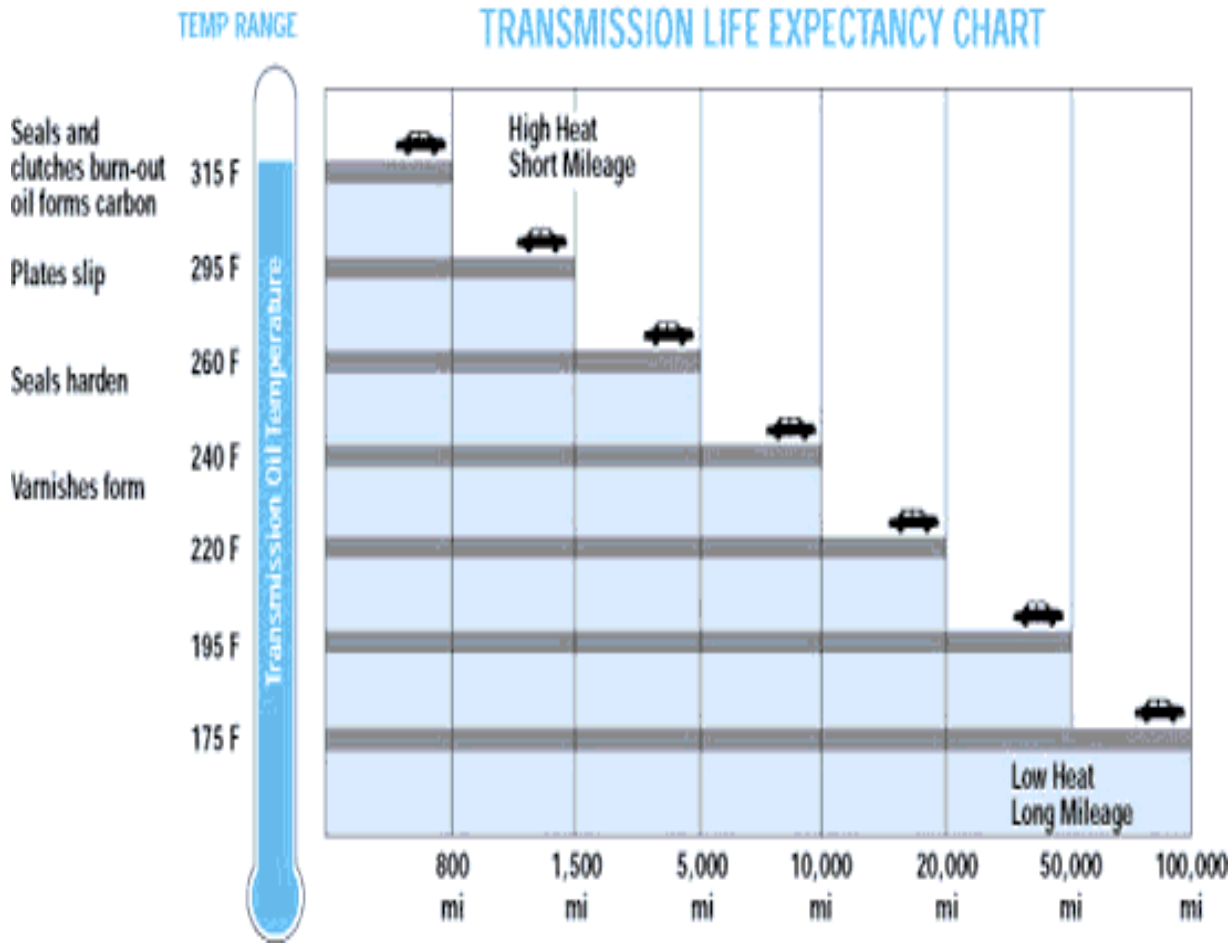
LT225/75R16LR[rating]	8.75R16.5LRE
Max Load/axial (lbs)	Max Load/axial (lbs)
1940 lbs @ 50 psi	1840 Lbs @ 50 psi
2060 lbs @ 55 psi	2005 Lbs @ 55 psi
2190 lbs @ 60 psi	2165 Lbs @ 60 psi
2335 lbs @ 65 psi [D rating]	2350 Lbs @ 65psi (GMC manual)
2440 lbs @ 70 psi	2515 Lbs @ 70 psi
2560 lbs @ 75 psi	2680 Lbs @ 75 psi
2680 lbs @ 80 psi [E rating]	

20% LOW TIRE PRESSURE (65 TO 52 PSI):
NEEDS 10% MORE POWER, &
ALL STEEL SIDEWALL WIRES MAY FAIL

23% OVERPRESSURE (80 VS. 65 PSI) REDUCES TIRE PATCH, TRACTION & TIRE TREAD LIFE BY 25%

U.S. INDUSTRY STANDARDS FOR TIRE MANUFACTURES WARRANTEES ARE 6 YEARS FROM DATE OF PURCHASE, NOT MANUFACTURE DATE.

RECOMMENDED TIRE REPLACEMENT IS BY WEAR STRIP, DAMAGE, AND 2/32” DEEP SIDEWALL CRACKS & IS NOT TIME LIMITED.



“Heavy Duty rating” is for additional cooler for towing 2,500 to 5,000 lbs. Cooler normally mounted front of A/C condenser with oil flow in parallel.

90% of transmission failures are due to overheating. Every 20 F drop in oil temperature doubles transmission life. (DrawTite web page)
GMC Operators manual specs for ~12,500 lb coach and 1,000 lbs tow

This chart was copied directly from a transmission cooler manufacturer. I assume that the temperatures are oil pan temperatures.

It shows the effect of increased temperature on the transmission oil and transmission components caused by increasing loads. As the loads increase beyond the original design loads, the built in transmission cooler will no longer be able to keep the fluids in the design temperature range.

Higher temperatures will start to toast the oil. That will affect all the oil in the transmission. Changing the toasted oil and filter with a transmission service will not correct the problem as most of the toasted oil remains in the transmission. Manny Trinova suggested raising the front of the coach 3 feet to drain almost all the transmission oil. He, like some other transmission shops, is not in favor of the transmission flush technique.

GMC Motorhome owners have done two solutions:
Add an additional transmission oil cooler in parallel to the existing one in the GMC radiator.

Change to Synthetic Automatic Transmission Fluid (ATF) so the transmission can operate at higher temperatures without degrading the fluid.

GMC Motorhome Turbo Hydra-Matic Transmission gear ratios
[Information from GMC manuals for standard 3.07 final drive ratio.]

Transmission Gear Ratios
L = 1st = 2.48:1 up to 5.5:1*
S = 2nd =1.48:1 up to 3.2:1*
D = 3rd =1.00:1 (*ratio increases up to 21%*)
***L and S can be multiplied by as much as 2.2:1 depending on the slip speed of the converter pump and turbine.**

Downshift will happen up to 70 mph in D. At lower speeds, downshift will occur at less throttle openings- without the use of the downshift switch (usually set for a floored accelerator pedal). *Reducing the throttle (less vacuum) may cause it to shift back up to D. It is common practice to shift into S on long grades to prevent it from shifting back and forth as the grade and throttle/vacuum varies.*

75 mph maximum recommended speed in S .

Braking. A shift to L will phase in S until speed drops to 45 mph, then shift to L and will remain in L regardless of vehicle or engine speed.

This chart is from the GMC manual's information for standard 3.07 final drive ratios. Changing the final drive ratio to a higher number will also increase the effective gear ratios of the others. The highlight of this chart is to show the amount of increase in the effective gear ratio under load by the Torque converter, which we hear as slippage.

During the seminar discussions, Manny recommended manually shifting into second gear (super) to lock the transmission in second by at least 45 mph when going up a steep or long hill for a 3.07 final drive GMC. Allowing the motor to slow down will reduce the transmission hydraulic pressure that prevents the clutches from slipping under load. The down shift switch is meant only for passing where lifting the accelerator petal from the down switch position will enable the transmission to return to high gear.

MOTORS AND DYNOSHOP TESTING RESULTS

A GMC Pacific Cruisers rally was held where 19 GMC owners had their coaches tested on the Dynometer. My Coop motor had been Dyno tuned. As a preamble to that rally, a questionnaire was filled out by members attending the rally that asked for motor size, any modifications, final drive gear ratio, driving speed, tow weights, and mpg in an effort to find some relationships in mpg results. No correlation was possible. Most owners reported between high sevens to the high nines in miles/gallon. The reason for this inability to correlate data was shown by the widely varied out of tune conditions identified by the Dyno test results.

All of these California coaches have carburetors, so there is no fuel injection system tested. Each member received the results of their coach's test along with a description of any identified anomalies. DynoShop ran a $50 club special on Saturday. The normal test is $105 with full Dyno tuning averaging an additional $400, and usually includes carburetor rebuilding and ignition work. Dyno tuning is by reservation and includes before and after tuning Dyno test results.

The DynoShop testing consisted of two types of test:

The tested coach is held on the Dynometer at a constant speed above the shifting to high speed (58 mph for the 3.07) and the load, and resulting torque, was increased to the maximum. This test shows the carburetor performance in terms of air to fuel (A/F) ratio across the full load spectrum. The ideal A/F ratio is 14.7/1, which theoretically burns all the fuel. DynoShop's experience has shown that the best drivability ratio for the carburetor equipped GMC motorhome is a ratio nearer to 14/1 at the normal driving speeds with maximum power nearer to 11.5/1.

The tested coach is held on the Dynometer and the speed increased until the transmission shifted into second and then accelerated under full load up to maximum rated hp rpm/speed. This produces test results in maximum torque and HP data throughout the second and high gear driving speed range. In plotting for comparison data, only the maximum torque was plotted and truncated at 80 mph. Unusual results and owners supplied information were added to the charts. Similar coach motors and gear ratios are plotted on one chart for ease comparison.

Unexpected Dyno test results.

The test results were inconsistent because every coach had some degree of out of tune and would benefit from a Dyno tune. Even the best-tested stock 455 had a carburetor that would not go to the maximum vacuum. The worst coach had 25% less torque than the best-tested value.

7 of the 19 tested had major identified ignition or carburetor problems that were passed on to the owners. Other hidden problems may exist that would be found during a Dyno tune.

Two had no secondaries operation for maximum power. (suspect mechanical problems)

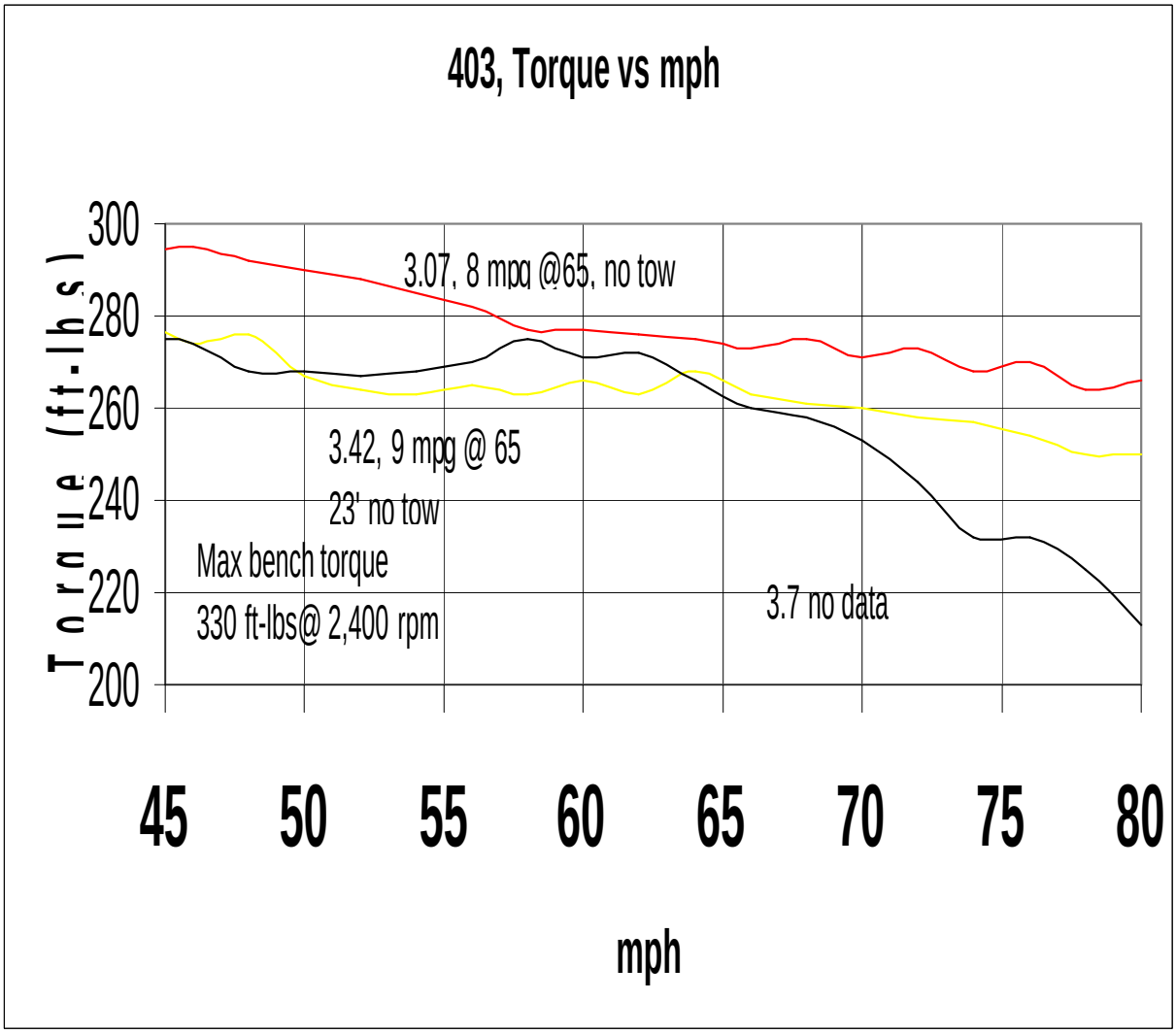
One had an inoperative TVS switch, which prevented vacuum advance.
Two had no mechanical advance

One had A/F ratios of 15.7/1 at cruise speed & 13.8 at max power. That motor always ran hot with 25% less torque, which would go along with an air leak creating a lean mixture.

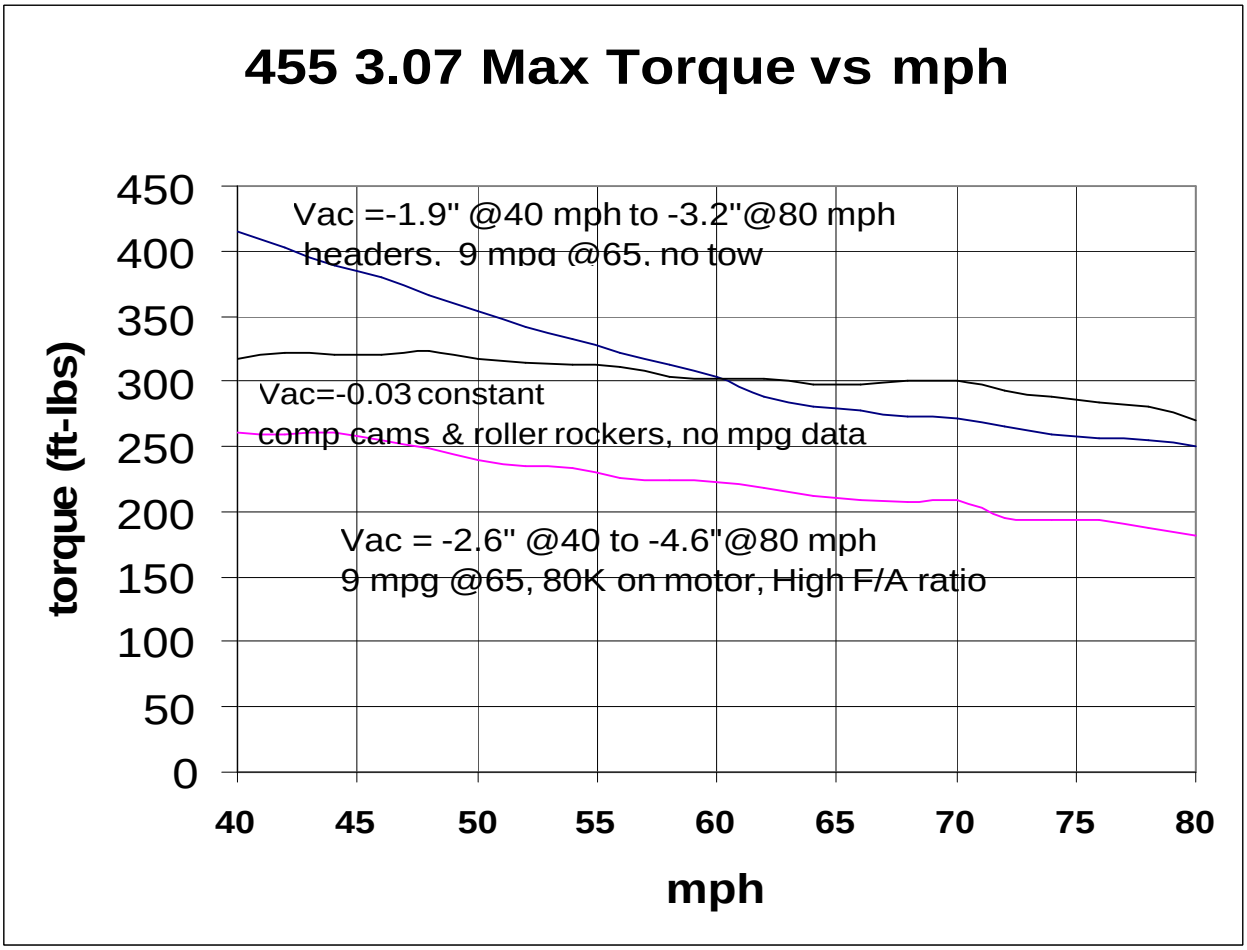
One had a Jeep air cleaner system where the air intake was in front of the radiator for cooler air. The motor would not go above 3,100 rpm until the air cleaner was taken off. After that, the motor ran strong on up to 4,200 rpm. The problem was solved by adding a 1” riser at the carburetor intake to allow the airflow to complete its 90 degree turn when entering the carburetor.

For the charts, all coaches are 26’ except the ones identified as 23’ along with tow weights for mpg comparison.

Ignition advance was not recorded. Limited ignition advance will cause a lower than capable maximum torque condition.



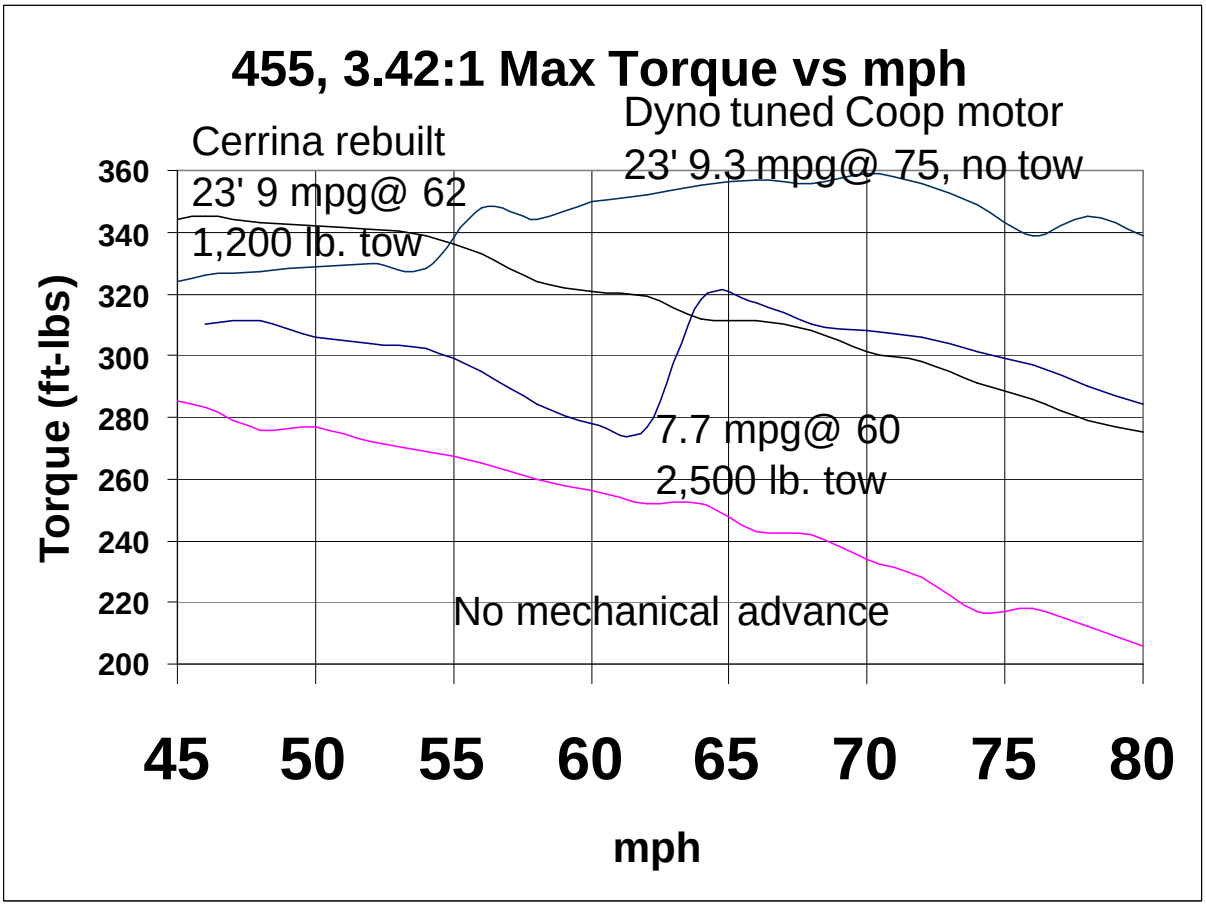
This 403 motor chart shows just the inverse of what would be expected. The 26’ with 3.07:1 final drive had higher torques across the driving speed range than either the 3.42:1 or the 3.7:1 final drives. The 26’ 3.07 coach had one mpg lower claim than the 23’ with 3.42:1. Both were driven at 65 mph. Not one of the three had full load vacuum reading below -1.5” indicating less than ideal carburetor functioning. The 403 with the 3.7:1 final drive ratio had the least vacuum at full load (up to -2.4 inHg vacuum), indicating there might be some carburetor-associated problems even though it had an F/A ratio of 11.8 at 80 mph.



This is the standard as delivered configuration. The wide variations in results again highlight the wide variations in tuning.

One motor was not stock which shows up as a uniform torque across the speed range. The owner reported changing the cams and roller rockers, resulting in a nearly constant torque of 300 ft- lbs up to 70 mph with a very slight decline of torque of 288 ft-lbs at 75 mph. Although the vacuum was a constant -0.3 inHg through out the test, the A/F ratio progressively leaned out above the maximum power value after shifting into third at 58 mph and 2,592 rpm. Armed with this detailed performance information, the owner can decide if he wants to improve his performance by tuning his carburetor to match his unique cam. That is the kind of tuning that Dyno Shop does.

Neither of the other two stock motors was at the desired vacuum values at maximum torque.



Cerrina had his motor recently rebuilt to Bob Lamey's "stock" specification and represents the best of the 455 motor test results. Again, it shows the declining maximum torque characteristic of the stock 455 motor. However, to put this into perspective, this is under the maximum torque conditions that only happen under maximum load when the accelerator is "floored". Under normal driving conditions, the rpm is much lower and closer to its rated peak value. The detailed test results showed that the A/F ratio was above 14/1 under all normal driving conditions and only dropped to 12.7/1 at maximum power condition. The maximum torque test vacuum condition started at -1.5 inHg and increased to -2.0 inHg at maximum speed. Other 455 vacuums measured as low as -0.1 inHg.

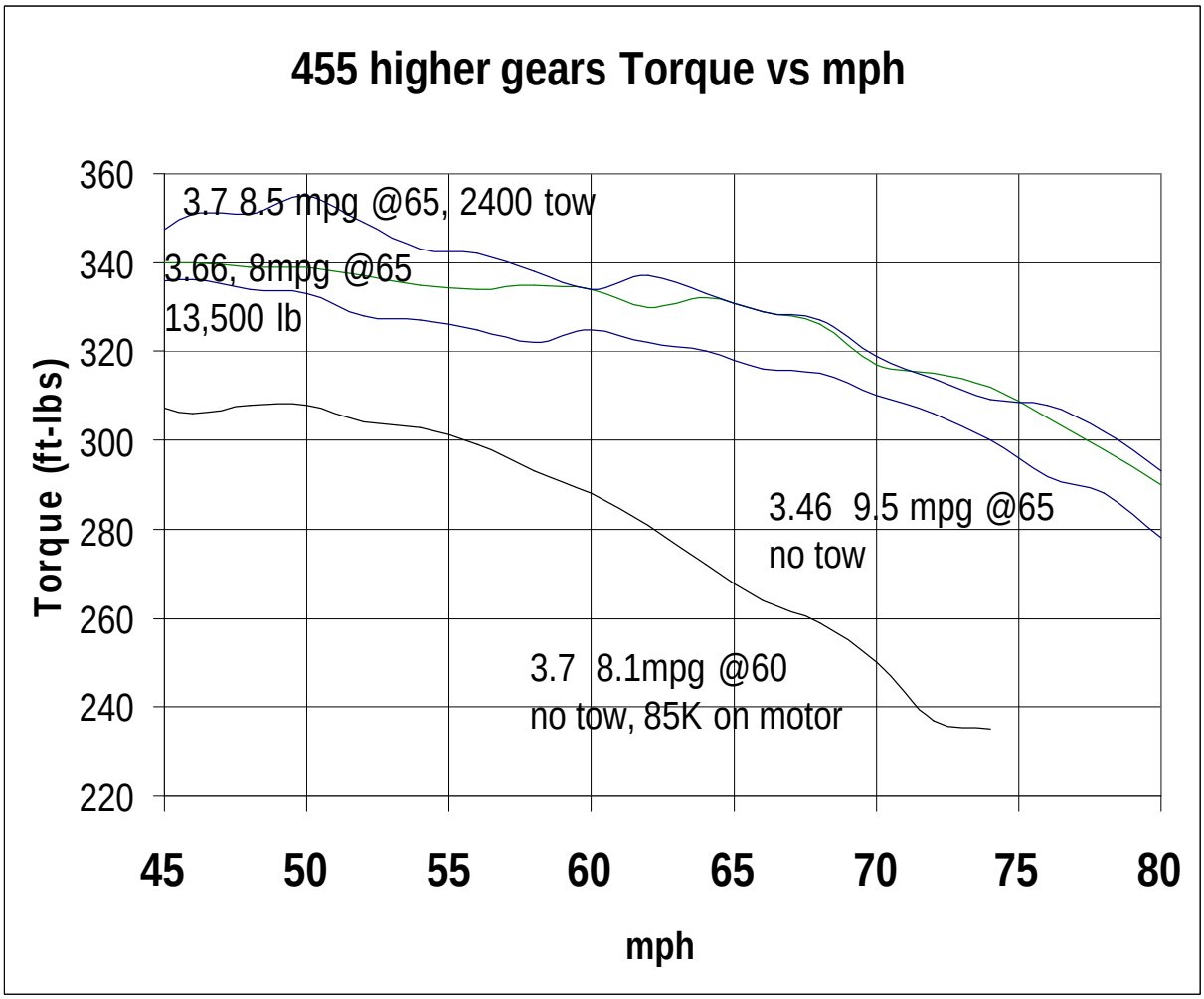
Cerrina' s coach is a 23'which he said achieves 9 mpg driving between 60 and 65 mph pulling a 1,200 lb tow. The combined 23' coach weight and 1,200 lb tow would be close to the weight of a 26' without a tow.

The Dyno Tuned Coop Motor is both a higher torque and higher rpm motor that takes advantage of the 3.42 gearing. The Coop motor has 36% more maximum torque than a stock 455. The bench test maximum torque values were placed on the chart to show why the motor maximum torque curve is so different from a stock 455. Where the stock 455 maximum torque declines after the shift into high at 58 mph under full load, the Coop motor, with 3.42 gearing, produces the maximum torque across the full driving speed range. The bench testing of the development motor shows a maximum torque of 467 ft-lbs @ 3,100 rpm (65 mph under full throttle).

The coach with the 2,500 lb tow and claimed 7.7 mpg showed a rich F/A ratio across the full range along with a less than desirable vacuum under full power of -1.7 inHg. The coach with the wide torque curve at second gear shifting and 7.7 mpg had an inoperative TVS switch, which prevented vacuum advance. The maximum torque curve was the most unusual with a rapid fall off of maximum torque at higher rpm as indicated by the jump in maximum torque at the shift from second into third.

The coach with the poorest maximum torque performance shows what happens when there is no mechanical advance. The A/F ratio was ideal across the torque/speed range as well as the vacuum at maximum torque reaching the desired -0.1 inHg. The owner did not submit any mpg or speed data.

Second gear torque shows higher, but declining, maximum torque produced up to the shift point with a smooth transition of torque and rpm at the shift into third gear. Under maximum torque conditions, the standard motor's torque does not drop with the shift into third gear. The two standard motors show further declining maximum torque as the speed and rpm increases because the motor is beyond its 2,400 rpm rated peak torque both before and after the drive train shifts out of second (super) gear. From these test results, declining maximum torque above the rated 2,400 rpm seems to be the characteristic of the both the 403 and 455 stock motors.



All the higher geared coaches show the expected higher torque that is desired for those higher loaded coaches except the one with 8 mpg at 60 mph with no tow. That owner quoted 85,000 miles on the motor, but it had two problems that were identified that the owner can elect to fix. The first was that there was no mechanical advance. The second was that although the A/F range was richer than normal though out the speed range, the vacuum was between -2.3 @ 45 mph and increased to -3.0 @ 72 indicating that there might also be some additional carburetor-associated problems.

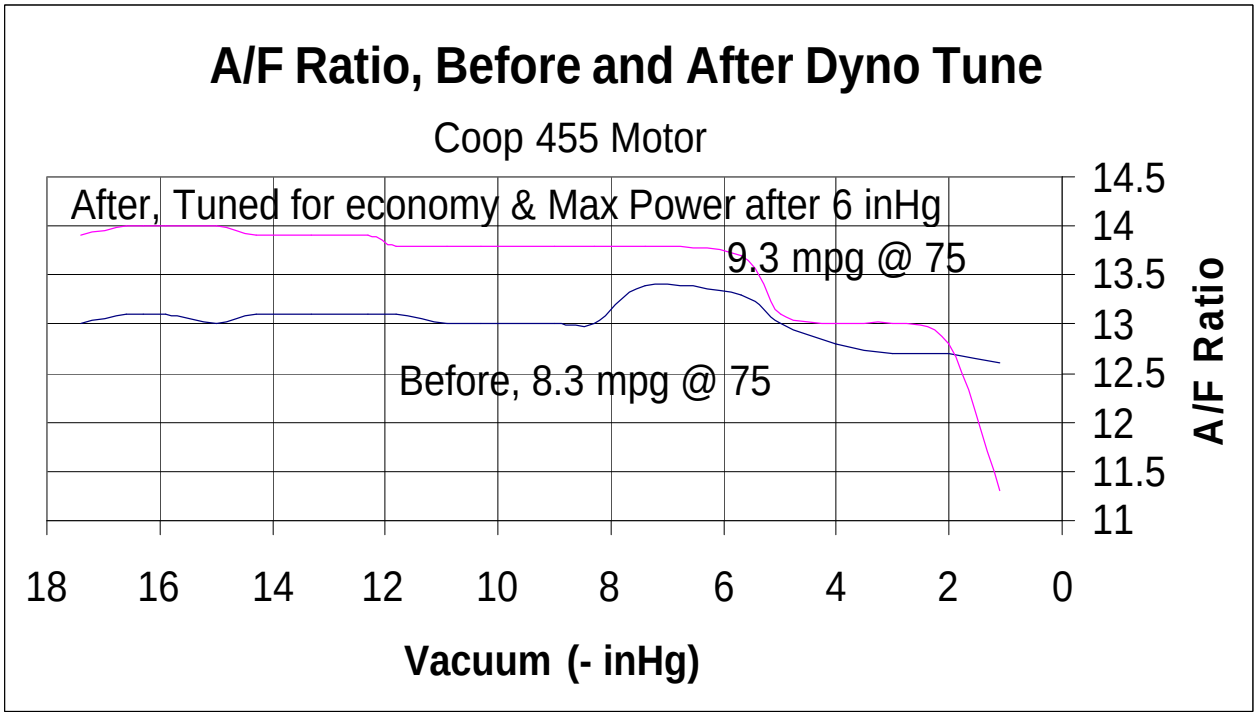
COOP MOTOR

Jim Bounds, owner of Cooperative Motor Works, has developed new 455 and 403 replacement motors that are available and being installed by selected dedicated GMC service shops. He has called this motor the Coop Motor. It is remanufactured, not rebuilt, by Jasper Racing Division and incorporates all the latest manufacturing methods, quality control techniques and Jasper warrantee, which is covered later.

The GMC owner now has the option to have a motor that was bench tested to within 6% of the torque rating of the FI 454 crate motor at a fraction of the installation cost. The Chassis dyno tuning of the Jasper remanufactured Coop motor after 3,000 miles of break in increased its torque by 5.6%. To achieve the increased power, non-standard carburetor jetting and ignition advance settings were done by the Dyno Shop after the 3,000-mile break in period.

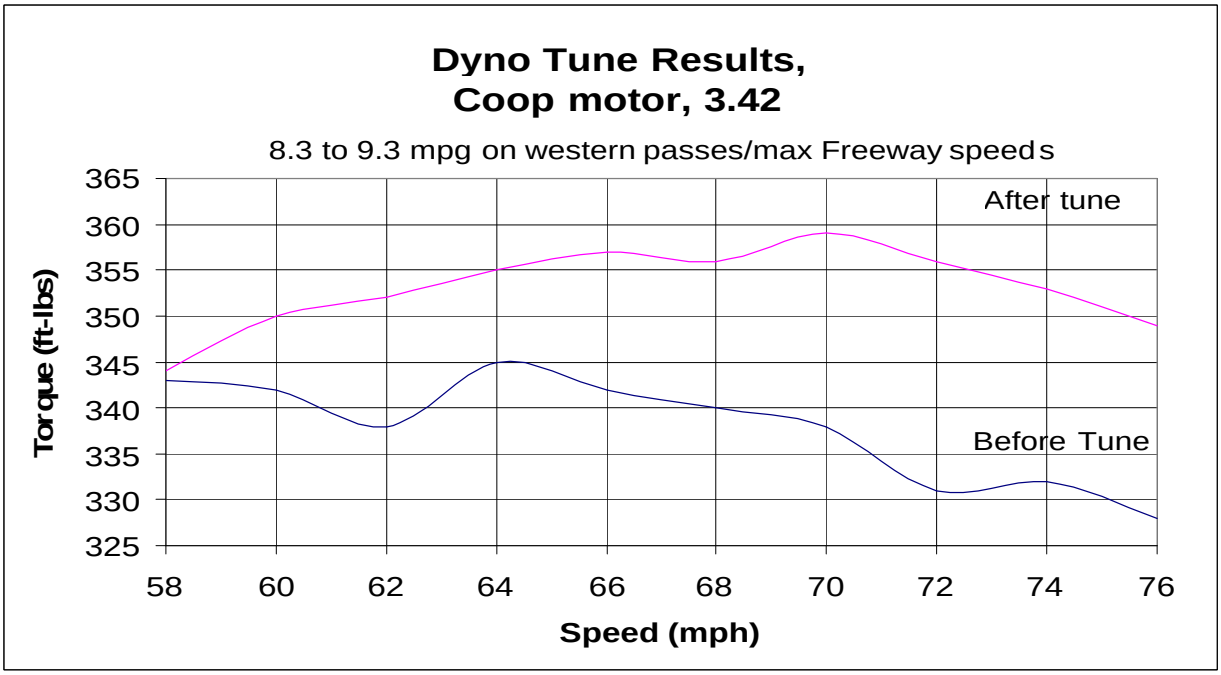
Jim Bounds incorporated all the known techniques for a high torque motor in addition to details for a long reliable life like the double roller timing chain. A couple of benefits of the modern remanufacturing method that I have noticed is a constant 65 psi oil pressure even at warm idle and, like a modern car, less than a quart of oil being used between oil changes after the second oil change. A Jasper service representative recommended retaining the 3,000-mile oil/filter change interval and using regular 40-weight oil for the initial 10,000-mile break in before going to Mobil 1 Synthetic Oil.

The Coop Motor's 36% more power is developed at 3,100 rpm compared to the stock motor maximum rated peak torque at 2,400 rpm. To take full advantage of this higher rpm motor, a change in the final drive ratio is necessary. What ratio would be best is determined by the load and driving speed. My 3.42:1 ratio produces a cruise speed of 75 mph at 3,000 rpm on the level. (3.55:1~72 mph, 3.7:1~69 mph) On 6% freeway grades, 3,100 rpm drops to 65 mph at near full throttle due to the torque converter operation. The Coop motor was developed to use 85-octane gasoline with an 8.75 Compression ratio (165 psi).

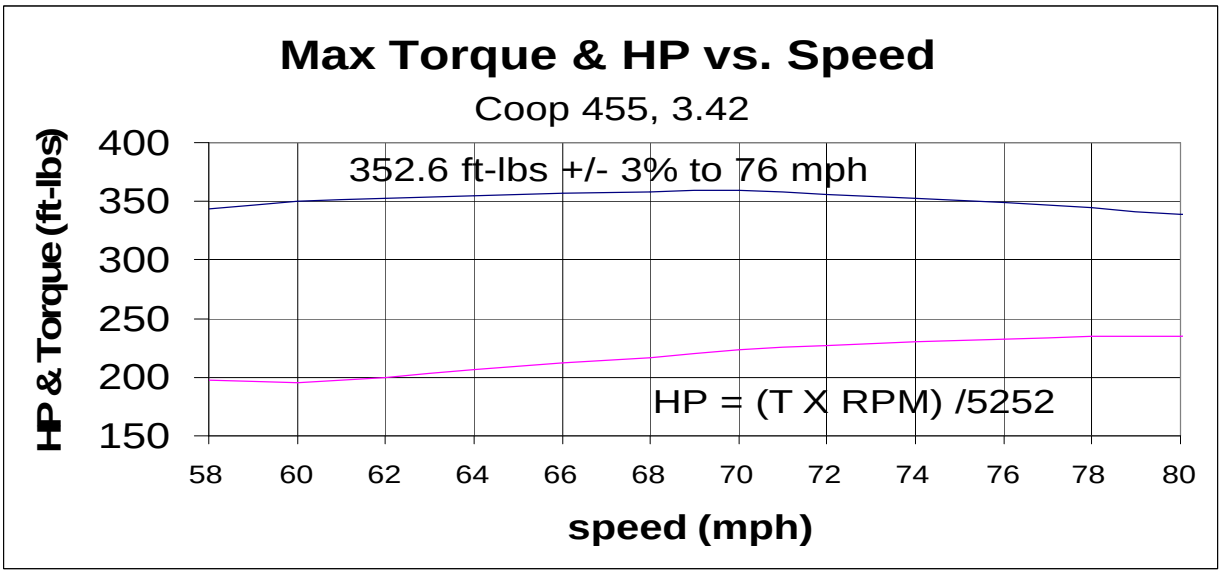


The standard GMC carburetor set up does not provide the benefit of either improved economy or increased power that the Coop motor can provide at its higher rpm. The normal sequence of DynoShop tuning is to run the motor “as is” to determine what needs to be changed. Although the carburetor was rebuilt for the new Coop motor, it had to be disassembled to make necessary changes. Both the primary and secondary jetting were changed to adjustable rods and the timing was set to 10 degrees at 700 rpm, 20-degree centrifugal advance @ 4,000 rpm, and 15-degree vacuum advance.

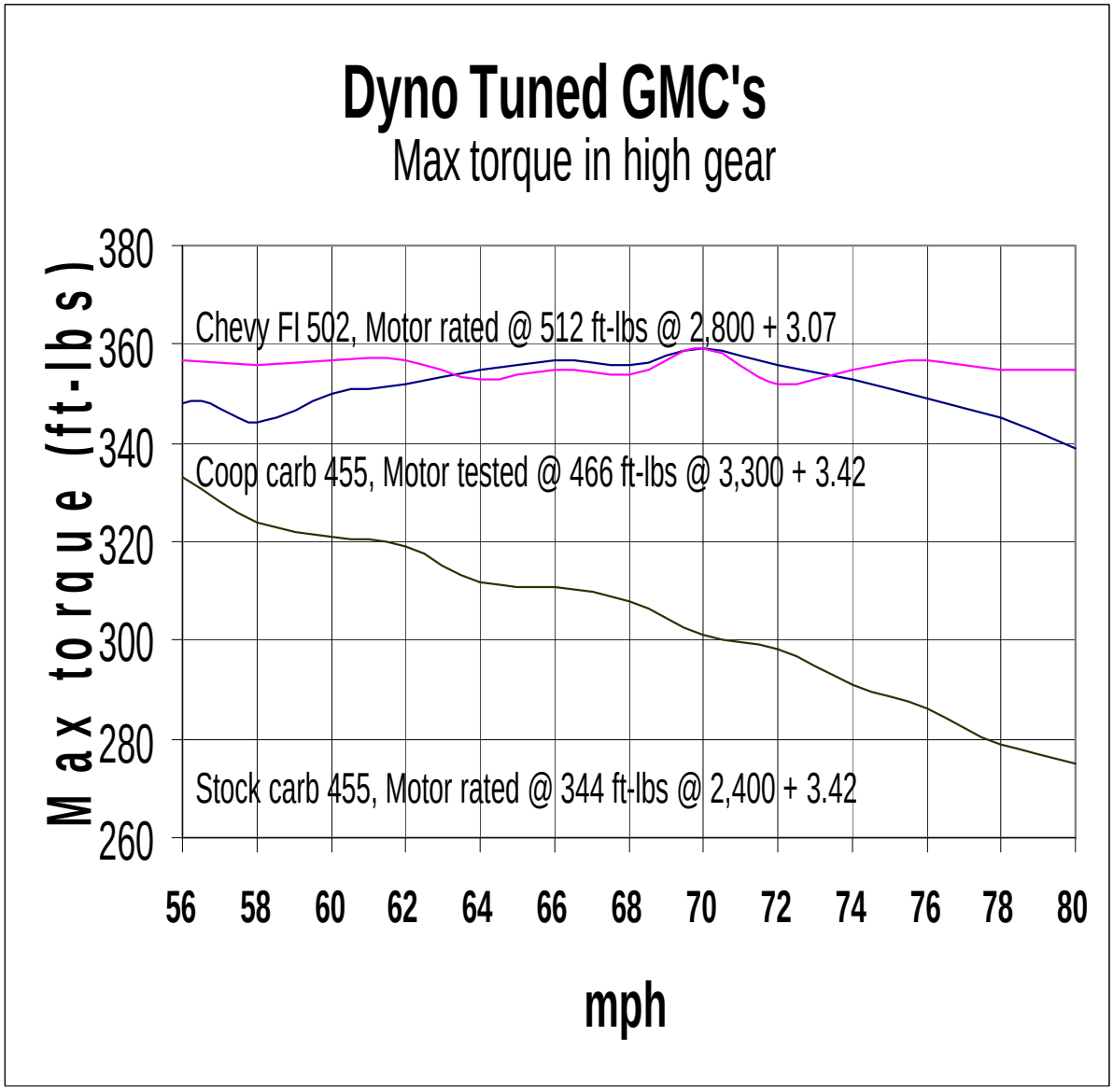
One look at the graph and it is easy to see that at low vacuum of -15 to -18 inHg, the jetting is for maximum economy. Driving this coach on the level near sea level, the Coop motor runs at -19 inHg at 55 mph, -18 inHg at 65 and -16 inHg at 75 mph, all within it most economical F/A ratio range. At increasing vacuums, the A/F ratio increases up to – 6 inHg of vacuum where the power valves move the rods for increased gasoline flow and power. At 2 inches of vacuum, the secondaries are fully open and the F/A ratio have changed to the maximum power setting of 11.5 at –0.1 inHg of vacuum. DynaShop warned me that once I get below -6 inHg of vacuum, I would burn more gas for that added power and I could decide to either back off or use more gasoline. For most driving, I have opted to stay above 6” of vacuum except on long steep hills where I no longer slow down in high gear. I stay in cruise control and reset it to 65 mph on freeway grades to stay out of the last 2 inHg of vacuum. So far, this has worked up to 5,000 feet altitude. My 23’ coach only weighs ~10,000 lbs without a tow.



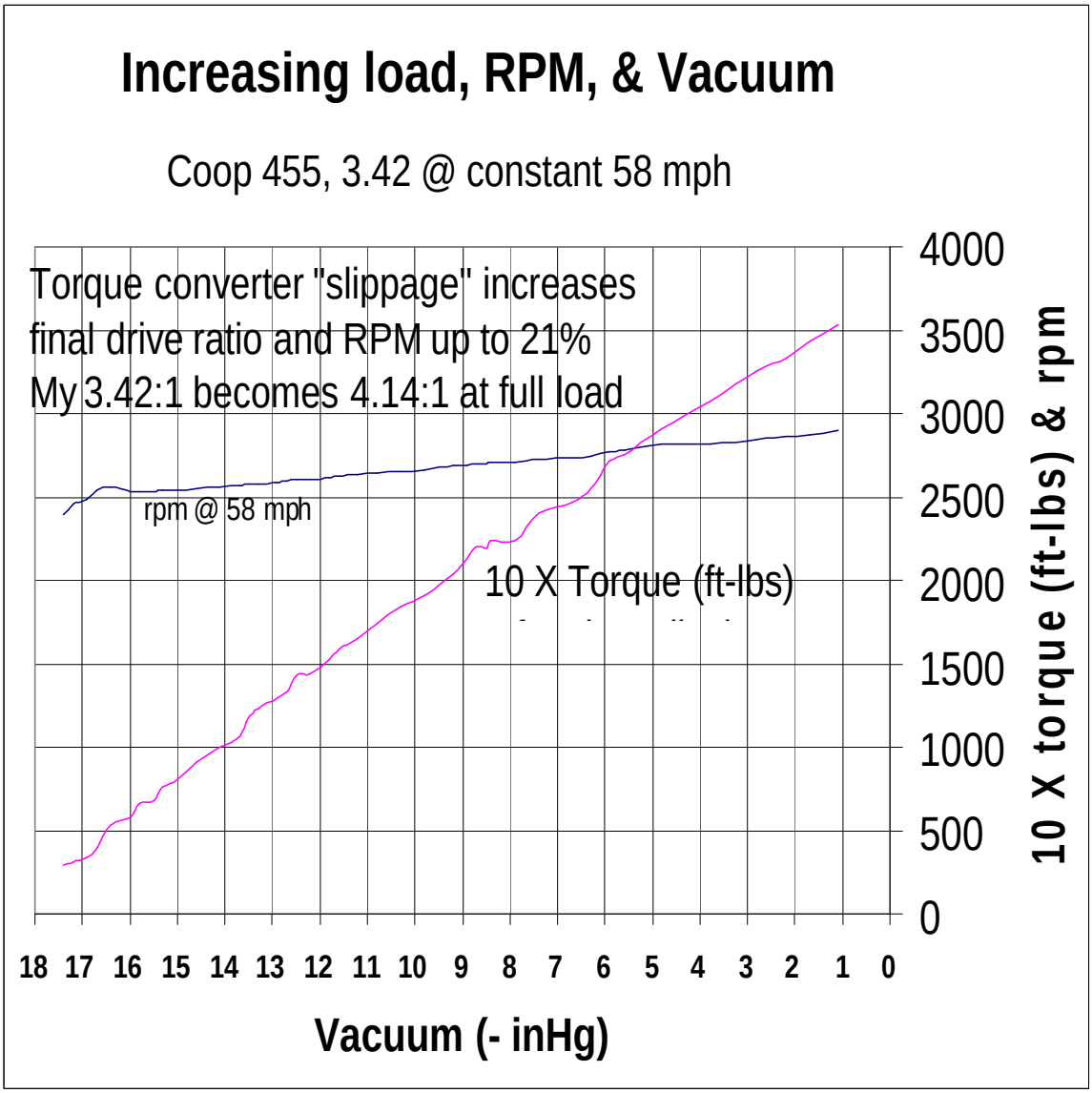
The change in maximum torque tuning shows how the increased A/F ratio increased the available torque at 70 mph by 20 ft-lbs or an additional ~6% while also producing a one mpg improvement while cruising at freeway speed limits.



This chart shows how the torque of the Coop motor with the 3.42:1 final drive produces a nearly constant maximum torque after shifting into high at 58 to 76 mph. The Coop motor develops its torque at higher rpm and takes advantage of higher gear ratios, which increase its power even more. The chart also shows how the decreasing torque at the higher rpm is not decreasing as fast as the rpm is increasing so that the net effect is that the maximum full throttle Dyno tested HP is still increasing up to 88 mph. (3,920 rpm). Dyno testing was stopped at 90 mph.



This chart shows the difference between the best stock GMC dyno tested (Cerrina) with 3.42 differential gear ratio and the dyno tuned Coop-motor with the same differential gear ratio. For comparison, I also plotted a Dyno tuned GMC with a Fuel Inject 502 Chevy motor with a stock 3.07:1 differential gear. It shows that the 455coop motor with 3.42:1 gearing is very close to the same maximum torque produced by the larger FI 502 Chevy motor with the stock 3.07 gearing.



This is unique to the GMC Motorhome Turbo Hydro-Matic Transmission. It shows how an increasing load at a constant speed increases the vacuum, torque, and rpm by continuously changing the effective gear ratio by what we hear as Torque converter “slippage”. Under maximum torque conditions, the 3.42:1 differential gearing effectively becomes 4.14:1 gearing. To show these interrelationships, I chose to multiple the torque values by ten so that it would have the same Y scale as rpm.

DIFFERENTIAL GEARING

Jim Kanomata, whose Applied GMC is a dedicated GMC motorhome service center, also makes, and sells higher differential gear ratios for the GMC Motorhome.

He spent some time explaining and showing the differences in the standard gears and his higher ratio gear sets. He makes both a 3.55:1 and a 3.7:1 for the GMC community and others who use this transmission and final drive train. He had samples of the stock gears as well as his gear sets to show the increase in tooth thickness for improved strength and life. His warranty is for 5 years, 50,000 mile.

He has sold over 700 of these units without field failures. The customers who benefit most from these higher ratios usually have above weight coach and tow combinations and/or live in high country where the power loss due to high altitudes is noticeable. He explained that he is in the process of developing and testing a higher ratio 4.1:1 gear set to meet those requests for more power.

He brought his catalogs for those who might be interested in higher gear ratio differentials. His catalog states:

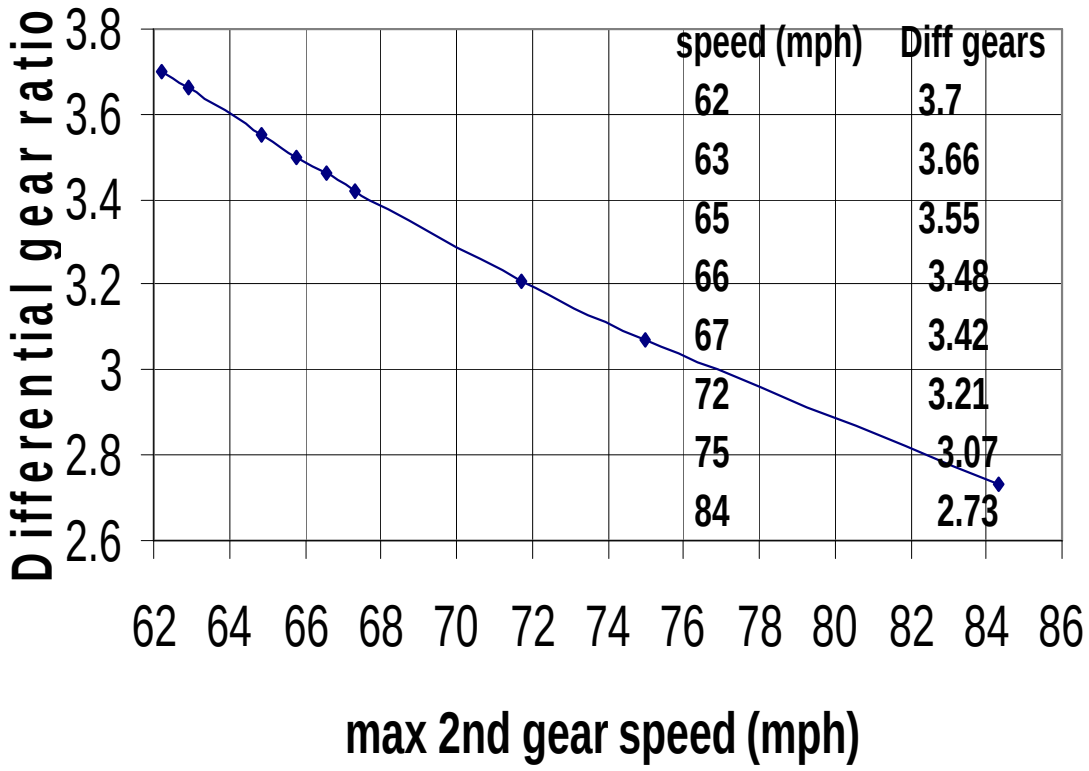
70% claim more power and the same mileage,

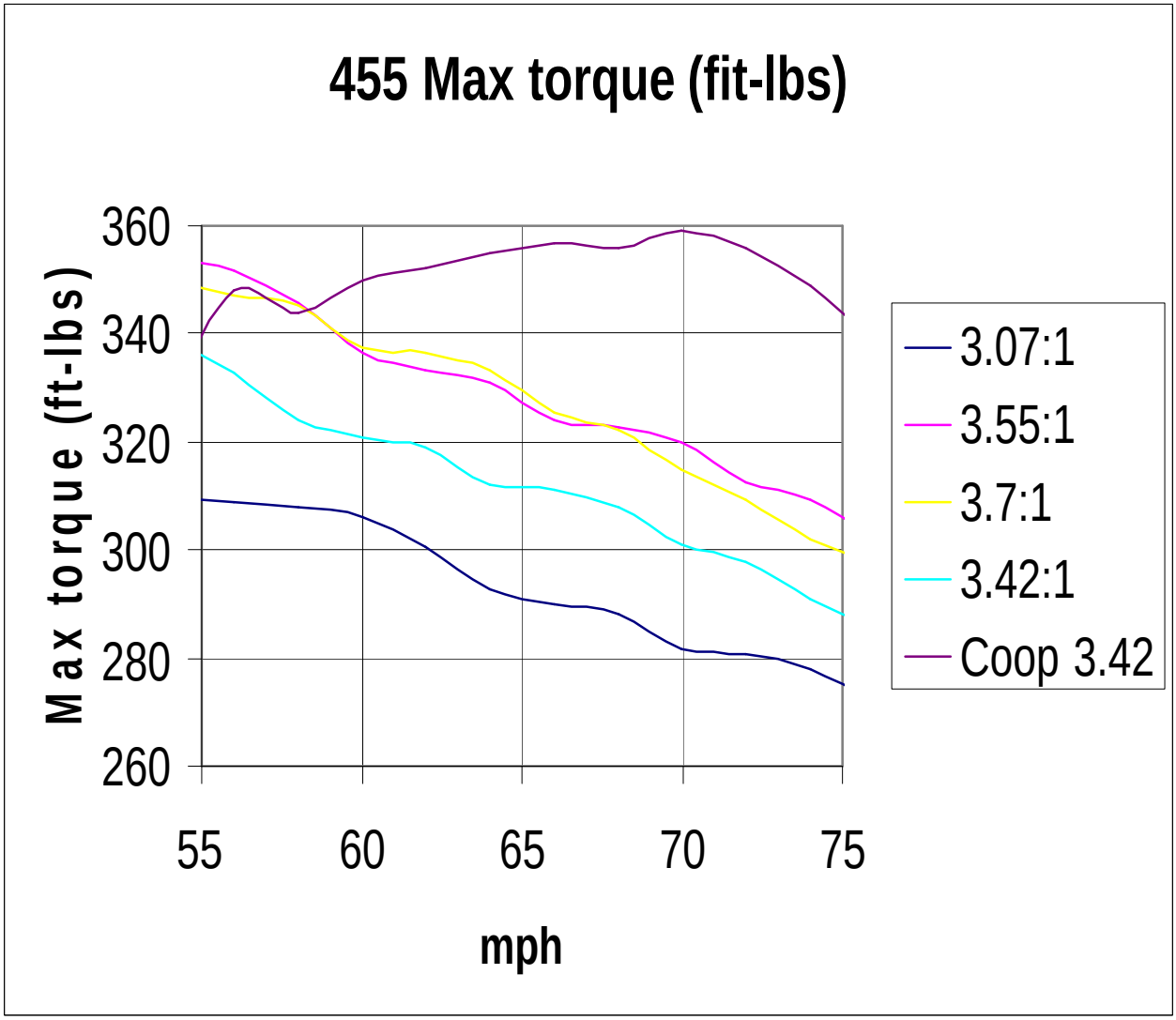
20% claim more power and better mileage,

10% claim more power and less mileage with 85% of those had ignition or carburetor problems. Viewing the results of the GMC Pacific Cruisers Dyno test rally, that is easily to understand.

Max 2nd speed vs Diff gear ratios

From GMC owners manual for 3.07



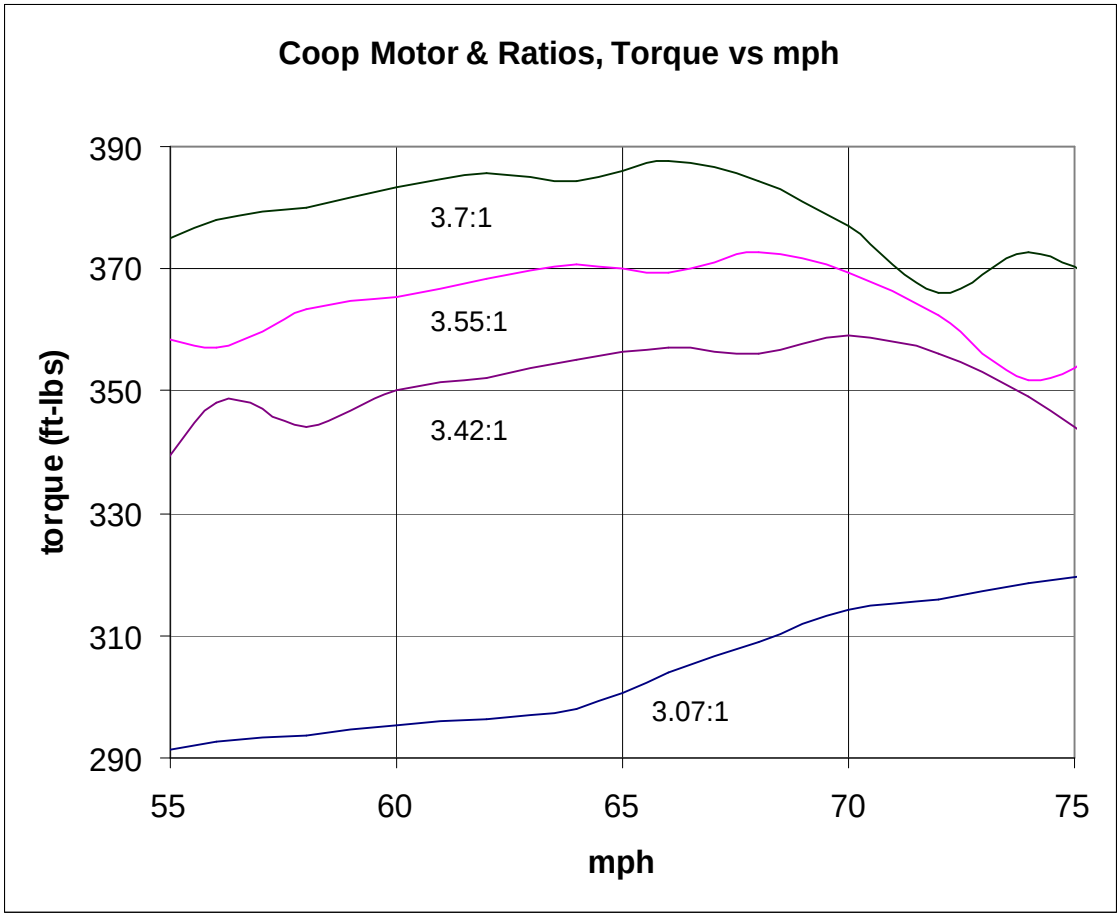


I took the dyno test data of the best stock 454 (Cerrina rebuilt motor with 3.42 differential) and extrapolated that data by changing the speed and torque at that speed to what it would be with the most common listed differential gear ratios. The calculated results shows the effect of that rapidly decreasing motor torque with increasing rpms with the cross over the 3.55:1 and 3.7:1 happening at around 67 mph.

Flooring the accelerator pedal for maximum torque also increases motor rpm by 20% as the transmission's torque converter increases the effective gear ratio by 20%. Under the maximum torque conditions at 60 mph, the stock motor, with any available gearing, is past its peak torque rating of 344 ft-lbs at 2,400 rpm and further decreases with increasing speed and rpm.

The Coop motor's higher bench torque of 467 ft-lbs at 3,100 rpm was increased by 20 ft-lbs by DynoShop tuning, measured at the tires, at 3,200 rpm. This motor with 3.42 gearing shows its increasing maximum torque above 60 mph compared to the standard motor decreasing maximum torque with any available gear ratios.

Using the same method, I extrapolated the Coop motor DynoShop Tuned test data to plot the it's maximum torque with the various common gear ratios. Again, the Coop motor's higher rpm torque peak shows that with the stock 3.07:1 ratio, the motor's maximum torque potential is only available in second gear, similar to the current stock 455 motor. The higher gear ratios all produce peak torque between 65 and 70 mph. A heavy rig, at higher altitudes, climbing a 6% grade, would be beyond any of these combinations to achieve those speeds in high gear. Under those conditions, second gear would still be necessary. With less severe conditions, the higher gear ratios would always give the coach a more responsive feel and would reduce the frequency of shifting into second gear compared to the standard 455 motor.



Jim Kanomata also talked about the four Coop motors that he installed for customers this year. California emission laws limit changes in the approved emission equipment for 1976 and later Motorhomes.

Jim talked about, and wanted to emphasize the Coop motor's advantages over other options from the service point of view. The motor looks, is installed, and is serviced identically to a standard 455. What is unique is inside the motor and is not affected by the California emission rules. All remanufactured motors from Jasper Racing have had their cams run in before it is delivered so it has had an initial run in, final quality control inspection under power, and initial oil change.

From Jim's point of view, it is not only competitively priced compared to other rebuilt motors, it is 36% more powerful and most important from him and his customers is that it carries the Jasper Racing Warrantee.

The Jasper warrantee is for class II gas engine cars and trucks. It is 6 months or 8,000 miles parts and labor reimbursement at any facility in US or Canada. Labor rates are proportional to the area rates with a max lid currently of $57/hr. Preferred installers (those who currently work with Jasper) are reimbursed @ $65/hr. Call Jasper or go on their web site to find the nearest preferred installer. The warrantee also covers the next 6 months (12 months) or 16,000 miles for parts only.

This relieves Jim and his customers of one of his biggest, after sale, new motor service problems. Jim talked about the problems he had in the past servicing a customer who had new rebuilt motor problem thousands of miles away from his shop. The customer with a Jasper remanufactured Coop motor problem can now go to any shop in the US or Canada, or to a Jasper installer, for problem analysis and even solutions, all under reimbursement warrantee.

MSD ENGINE KNOCK ALERT & IGNITION CONTROL

Grandpaw Billy completed the tuning discussion with his entertaining history of ignition methods evolving into our current automatic ignition advance system that includes both vacuum and centrifugal advance controls.

He then discussed the operation of the MSD Engine Knock Alert & Ignition Timing Control hardware enabling changing ignition timing with a turn of a knob on the dashboard. The driver can advance his coach's timing for the maximum power and economy while driving down the road. If that timing is too advanced when climbing a hill, a simple turn of the knob will retard the timing until the Knock Alert (both visual and adjustable sound level options) indicates that the dangerous knock has been eliminated. Once the hill has been crested, the knob can be readjusted for maximum power and economy again. The knob has a 15-degree range. GMCnet users who drive in the mountains report adjusting knock sensor by dialing in 1-1/2 degrees advance per 1,000 feet of altitude will keep the sensor indicating proper timing for maximum power and economy. The higher altitudes lower air pressure reduces the motors compression ratio making it less sensitive to pre-ignition knock
.
Grandpaw Billy said he sets his knob to 5 degrees advance before he adjusts his 455 timing. That gives him the flexibility to retard ignition if needed.

Dyno Shop installed my knock sensor microphone on the lower engine block near the passenger front motor mount just over the short shaft driveline. This location has proved to reduce valve train noise so that the Knock Alert would indicate only true knock conditions.